Chapter 6
Conclusions: Planning for flood resilient cities – from promise to practice?

6.1 Introduction

This thesis started out with explaining the growing risks of flooding in cities, worldwide and in Europe. The focus of this thesis has lied on European cities, as Europe has significantly suffered from flooding in the last two decades, leading to various discussions about adequate ways of flood risk management. Only relying on traditional flood control measures is increasingly recognized as inadequate, since the damage can be catastrophic if flood control fails. However, planning for reducing flood risk is impeded by uncertainties and changing circumstances – policy-makers do not know exactly how to plan and what to plan for. The most pressing uncertainty at the moment is climate change: scientists agree that the climate will be changing, affecting sea levels, precipitation patterns and storm frequency. Nonetheless, predictions are still uncertain, in particular for the regional and the local level. Moreover, future socio-economic development and interactions with the hydrological system are difficult to foresee. This raises questions about which areas will be most at risk, how society's values will develop and how this will affect future flood risk management.

Against this background, a paradigm shift in dealing with flood risks has been called for; from a 'predict and control' to an 'integrated and adaptive' regime (Pahl-Wostl, 2006). Recently, in science as well as policy discourses, the idea of a 'flood resilient city' has gained prominence. A city which can withstand or adapt to a flood event without being harmed in its functionality, and is even capable to transform to a new, less flood prone state when necessary. This sounds like a promising idea, but it also questions traditional approaches and institutions, asking for a stronger integration of flood risk management and spatial planning and new governance arrangements between state, market and civil society. Given the prominence and rapid adoption of the resilience concept on the one hand, and its tension with traditional flood defence approaches on the other, this thesis sought to advance our understanding how the resilience concept resonates in current flood risk management and urban planning practices, and which conditions are conducive for implementing flood resilience strategies in urban areas. Or in other words, *how - and to what extent - has this promise been brought to practice, and which conditions facilitate the implementation of flood resilience strategies in urban areas*?

Two challenges have stood central in this thesis. The first challenge concerns the meaning-making process of the resilience concept in practice. Given the novelty, but also the fuzziness and multi-interpretability of the concept, this thesis analysed how the resilience concept is actually made sense of in current strategy-making processes. For this purpose, this thesis first studied how two key notions of the

resilience concept – 'uncertainty' and 'adaptability' – have been framed in long-term flood risk management strategies in London and Rotterdam (RQ 1). Moreover, it explored how long-term flood risk management can be made more adaptive, and which opportunities and challenges policy agents encounter in this process (RQ 2).

The second challenge concerns the actual implementation process of flood resilience strategies in urban areas. While quite some knowledge is gained about which measures should be taken to achieve greater flood resilience, the actual implementation often faces a multi-actor and multi-level governance challenge. This thesis therefore aimed at identifying conditions for implementing flood resilience strategies in urban areas, by evaluating the decentralised implementation of flood resilience measures in London (RQ3) and the reasons for adopting a different flood risk management approach in Hamburg's HafenCity compared to the Leap across the Elbe project (RQ 4).

The goal of this chapter is to draw together the major findings of this thesis and embed them into a broader academic debate. All cases from this thesis have been studied against the background of how flood resilience is brought from theory to practice. The objects of analysis varied from long-term flood risk management strategies (in the regions of London and Rotterdam) to urban regeneration projects (in London and Hamburg). Comparable insights are drawn on the grounds of how the resilience concept resonates in long-term flood risk management strategies, which implementation issues arise in concrete urban development projects in flood-prone areas, and more general observations about the context of flood risk management practices in the three countries and cities. The main findings from each case are highlighted and connected to the findings of other cases where possible.

Overall, four main observations can be made, which will be explained in more detail below (see chapters 6.2 – 6.5). The first observation is that resilience thinking has left its mark on the policy language of long-term flood risk management strategies, but that this does not yet translate to fundamentally different measures and management approaches ('Resilience – more talk than action?', see chapter 6.2). As resilience is often considered to require an adaptive governance or management approach, the second main finding zooms in on the adaptive element of the long-term flood risk management strategies in the regions of London and Rotterdam. Despite diverging frames and governance approaches, the strategies reveal striking similarities in operationalizing the adaptive response in a technical-rational way ('"Adaptive strategies" – a technical-rational interpretation prevails', see chapter 6.3). The third observation is about path-dependency, which has been observed in all cases in terms of 'physical-spatial stickiness' as well as 'social-institutional stickiness' ('"Stickiness" and path-dependency', see chapter 6.4). The final observation concerns

the growing importance of the local level for implementing flood resilience strategies in urban areas and the need for central support to make decentralization work ('The growing importance of the local level: endowing responsibilities or shifting problems?', see chapter 6.5). Each of these sections ends with theoretical implications and practical recommendations about how to bring the implementation of the flood resilience concept forward. Finally, Chapter 6.6 presents an outlook and recommendations for further research.

6.2 Resilience – more talk than action?

This thesis started out with explaining the increasing usage of the resilience concept, establishing resilience as a new buzzword in academia and practice. Moreover, this thesis has operationalized flood resilience as robustness, adaptability and transformability, thereby overcoming the simplified dichotomy between a resistance strategy aimed at reducing the probability of flooding and a resilience strategy aimed at reducing the consequences of flooding (prevalent in all chapters, but mostly worked out in chapter 5). Dikes and other technical measures are an essential part of a resilience strategy, but there is more to it than that. As explained in chapter 2, resilience stands for a new way of thinking, a 'new narrative', about how to govern risks and uncertainties, thereby challenging the 'predict and control' regime of flood risk management. This shift, however, has mainly shown in the policy language used in long-term flood risk management strategies, less in the measures these strategies propose.

A new policy language...

Chapter 2 shows that a new policy language has emerged in the Thames Estuary 2100 Plan and the Dutch Delta Programme. The strategies worked out in the Thames Estuary 2100 Plan and the regional sub-programme Rijnmond-Drechtsteden both emphasize 'uncertainties' and refer to the 'interconnectedness of systems'. They stress that flood risks cannot completely be eliminated and that new approaches and new collaborations between state, market and civil society are necessary to deal with the residual risks. This is a shift, because flood risk management has usually been strongly concerned with providing certainty and 'dry feet'. The latter is even part of the constitution in the Netherlands. Consequently, new tools and specific policy terms have entered the policy arena, such as 'adaptation pathways' and

'tipping points' in the Dutch case and 'route map approach' and 'decision pathlines' in the English case. Uncertainties about climate change and future socio-economic developments are acknowledged as a major component of the problem definition, requiring adaptive responses as subsequent courses of action. In the Netherlands, the 'Adaptive Delta Management' has been created on a national level and then substantiated in the region of Rotterdam. In London, the Thames Estuary 2100 Plan itself has been coined an 'adaptable plan'. The emphasis on uncertainties and residual risks, and the endeavour to shape an adaptive response, fits within the idea of flood resilience and the ontology of evolutionary resilience thinking. Understanding these as two key elements of the resilience narrative, this thesis argues that resilience has started to leave its mark on the current flood risk management debate.

... but a continuation of the existing strategy?

However, Chapter 2 also makes clear that, so far, this is mainly a shift in language and the overall process of the strategy-making, but less so in the proposed measures. The main measures are targeted at reducing the probability of flooding; reducing the consequences of flooding is touched upon through disaster management, but there are hardly any efforts to increase the adaptive capacity behind the dike line. In both strategy-making processes, a variety of different flood risk management options have been considered. In both cases, this has also been highly appreciated by the involved stakeholders. As one of the members of the programme team in the Rotterdam case stated, thinking about the long-term perspective gave a feeling that 'everything is possible'. However, although many options were discussed, the filtering process in both cases eventually led to a continuation of the existing, primarily protection-oriented strategy.

For instance in London, the course of action set out for the coming years is a focus on option 1 ('improve existing defences'), with the possibility to make a decisions for option 3 ('a new barrier with locks') around 2050. This estuary-wide course of action then ought to be complemented with floodplain management, building flood resilience (e.g. floodproofing buildings) and improving emergency response. Together, they would serve as a diverse and holistic approach of dealing with floods. However, Chapter 2 already raised the first concerns about the implementation of more resilience measures such as floodplain management and capacity building in society, because their implementation depends on the willingness and ability of the local authorities. These authorities, however, were hardly involved in the process.

Chapter 4 validates these concerns. The implementation of Thames Estuary 2100 Plan's recommendations in the urban regeneration initiative project Royal Docks faces several challenges, including a lack of local ownership of the plan, a lack of clear guidance for floodplain management, and limited capacities within a local authority that has been struck as one of the hardest with austerity measures. Because the assessment of the actual flood risk has been changed, new assets like apartments and businesses and new people are placed in an area that is potentially prone to tidal, fluvial and pluvial flooding. Some precautionary measures have been taken, but the redevelopment of this area could have provided an opportunity to follow a more flood resilience based approach. The fact that this opportunity, although suggested in the Thames Estuary 2100 Plan, was not taken, shows that the sense of urgency around flood risk is at the moment lower than the sense of urgency around urban growth and development.

As described in Chapter 2 and 3, the strategy-making process in Rotterdam led to a similar result. The preferred strategy of maintaining and improving the existing system can be seen as a 'middle course'. Large-scale interventions like a ring of weirs or a closed dam to the seaside ('Delta Works 2.0') have been excluded, just like a broader spatial planning based approach to deal with flood risks. In the *Rijnmond-Drechtsteden* area, a different – more adaptive – approach to flood risk management is only followed in Rotterdam's areas outside the existing dike line, and in Dordrecht. Dordrecht is a unique case. It is the only place within the existing dike system where not all parts of the existing dike ring can be reinforced, because some parts of the dike ring are too close to historic buildings (see Chapter 3). Therefore, Dordrecht has become a pilot region for the implementation of the multi-layer safety concept, which combines technical protection measures with spatial planning and disaster management measures (Hegger et al., 2014).

Still, the involved stakeholders keep addressing the need for adaptability and the integration of spatial planning and water management. The ambiguous character of this plea results in a remarkable framing process, in which dikes are coined as 'adaptive' and 'every dike is seen as a spatial concept'. This is a remarkable framing in the sense that words like 'spatial concept' and 'adaptive' somewhat hint at a resilience strategy. However, simply changing the looks of the dike does not increase the adaptive capacity behind the dike line. Such framing follows logically from the middle course that was chosen: the existing protection-oriented approach is largely kept in place, yet it seems that this familiar approach is presented in a new coat ('old wine presented in new bottles').

A lingual resilience turn

Overall, chapters 2, 3 and 4 provide evidence that speaks in favour of a 'lingual resilience turn' in long-term flood risk management strategies. However, the strategies itself remain much more a continuation of the existing approaches, raising doubts about how much they will induce a paradigm shift or transformation. This leads to the overall conclusion that resilience so far is more accommodated in talk than action. The fuzziness of the resilience concept clearly leaves room for interpretation. In fact, the London and Rotterdam cases provide evidence for White & O'Hare's (2014) statement that adaptive language can be enveloped in an engineered understanding; at least in that sense, that words like 'adaptive', 'uncertainties', 'tipping points' and 'interconnected systems' are used, but the proposed measures remain primarily protection- and engineering-driven.

The finding that resilience so far is more talk than action is in line with other research, such as the observation from Kythreotis and Bristow (2017) that resilience language has been used in the UK context of climate adaptation policies to 'rebadge' existing strategies. Furthermore, Gralepois et al. (2016) observe that the Netherlands remains to follow a 'safety-first' approach. The emphasis on protection and 'safety first' also fits into a broader debate about the impact of resilience language on policy debates. While some authors emphasize the positive connotation of resilience as a means to strengthen local communities and the overall adaptive capacity of society (McEvoy, Fünfgeld, & Bosomworth, 2013), other authors see the rise of resilience as a manifestation of a 'discourse of fear' (Simin Davoudi, 2014; Evans & Reid, 2014). Because resilience is so much about shocks and disruptions, resilience language can come across as rather 'apocalyptical', framing nature as a threat rather than an asset for cities (Simin Davoudi, 2014). Comparing sustainability and resilience with each other, Davoudi (2014) speaks of a changing discourse from the 'postpolitics of hope' associated with sustainability to the 'postpolitics of fear' which underlies climate change and resilience. Following this line of reasoning, resilience language, as a reply to deep concerns such as climate change, reinforces 'securisation' as hegemonic discourse of our time (Coaffee & Clarke, 2017; Simin Davoudi, 2014). Securisation in this case refers to the need to defend cities and nation states against the 'threats' of nature. Framing climate change and nature as risk brings back modernist ideas of 'taming nature' and technical-rational management approaches (Davoudi, 2014). This can somewhat be considered a paradox: 'Paradoxical as it may sound, the risk-laden narrative of climate change simultaneously evokes pessimism about the apocalyptic future and optimism about our ability to securitise it through technologies of risk' (Davoudi 2014: 366) and further, 'the risk-laden discourses of

climate change elevate the demand for control, for policing nature, and for security' (Davoudi, 2014: 365). In this light, the inclination towards known and protection-oriented measures is not surprising. Yet it mainly shows that resilience can be interpreted in multiple ways, and that the transformative element of resilience can easily be neglected.

Nonetheless, it is still quite remarkable that these long-term and adaptive flood risk management strategies have emerged in the first place. It shows that climate change urges cities and nations to think about climate adaptation and, despite some political boost for climate scepticism, the public debate has helped to raise awareness and create momentum for more strategic and long-term thinking. Acknowledging uncertainties and becoming adaptive seems to have become a societal imperative. On the other hand, though, the strategy-making processes in both cases favour conservation over transformation, i.e. well-established and – until now – proven methods are preferred over new approaches that require authorities to take risks. In a way, the somewhat reluctant attitude of authorities when it comes to taking resilience measures demonstrate that so far there is neither enough need nor evidence to shift to a more transformative resilience strategy.

The way forward: towards resilience as a 'discourse of hope'?

For the further development and implementation of long-term flood risk management strategies, a positive framing and a move towards a 'discourse of hope' seem to be crucial. The momentum for more long-term thinking and strategic planning has been used, and has resulted in several new policy strategies using resilience language. However, the resilience concept has not been used to its full potential. Although resilience in general can come across as 'apocalyptical', this is not how resilience entered the field of flood risk management (see Chapter 1). The paradigm shift in flood risk management has been much more connected to hope and sustainability; the idea of the 'spatial turn' was to create more attractive living environments and come up with more sustainable flood risk management solutions at the same time. If policy-makers want to commit to a more transformative resilience strategy, it is important to go back to a positive connotation of the resilience concept, or, to speak in Davoudi's (2014) words, to move towards a 'discourse of hope' again. By stressing the multiple benefits of a place-based resilience strategy (improved protection against residual risks paired with benefits for nature and attractiveness of the living environment), a vision with a stronger emphasis on building long-term adaptive capacity can be created.

6.3 'Adaptive strategies' – a technical-rational interpretation prevails

Resilience generally implies an *adaptive* governance or management approach (Folke, Hahn, Olsson, & Norberg, 2005; Holling, 1978; Hurlbert & Gupta, 2015; Wilkinson, 2011). The second main finding of this thesis therefore zooms in on the framing of adaptability in long-term flood risk management strategies, particularly in London and Rotterdam. As chapter 2 and 3 show, the two cases adopt diverging frames and governance approaches, but reveal similarities in the actual operationalization of the 'adaptive response'. The adaptive response in the English case is manifested in the idea of an 'adaptable plan', whereas in the Netherlands it is operationalized with the 'Adaptive Delta Management' approach.

Diverging frames and governance approaches...

The English and the Dutch case adopted diverging frames in the strategy-making processes, leading to different governance approaches of these two strategies. The Dutch case has adopted a 'joint fact-finding' frame, acknowledging the possible existence of diverging views and perspectives. Consequently, 'a collective approach to developing knowledge' has been pursued, reflected in the variety of stakeholders involved from national, regional and local level. On the contrary, the English case has adopted a 'scientific pragmatism' frame. The Thames Estuary 2100 Plan emphasizes that additional studies and investigations need to be carried out to build an 'evidence base', to base decisions on 'sound science'. In the wider debate on classifying uncertainties, one could argue that the Dutch case has adopted a conceptualization of 'multiple knowledge frames', whereas in the English case a conceptualization of 'incomplete knowledge' has dominated (Brugnach, Dewulf, Pahl-Wostl, & Taillieu, 2008; Isendahl et al., 2009).

To an extent, these diverging conceptualizations stem from the respective national flood risk management debates. The 'joint fact-finding' frame in the Netherlands can be seen as a culturally motivated choice of basing decision-making on building consensus among a broad variety of stakeholders, expressed with the 'Dutch polder model' (Ashworth, Graham, & Tunbridge, 2007). Additionally, it can be seen as a way to find broad support, as water management in the Netherlands has formerly been accused of being too technocratic, with the national executive agency for water management Rijskwaterstaat being characterized as 'a state within the state' (van den Brink, 2009). English flood risk management on the other hand has been characterized with 'lost knowledge' and 'outsourced expertise' (Haughton,

Bankoff, & Coulthard, 2015: 375), while at the same time there is a general push for cost-effectiveness and 'evidence-based policy-making' (Clarence, 2002). The urge for more studies and a stronger evidence base therefore fits well into the English policy-making context. The interpretation and operationalization of resilience hence depends on the national context, leading to an interpretation of resilience that is coloured by the respective flood risk management tradition.

... but similarities in operationalizing the 'adaptive response'

Despite the above mentioned differences, there are quite some similarities in the operationalization of the adaptive response. As chapter 2 points out, these similarities are not surprising, since the 'Adaptive Delta Management' approach was inspired by the Thames Estuary 2100 Plan.

The 'adaptable plan' for the Thames Estuary and the Dutch 'Adaptive Delta Management' approach are both based on scenario planning. Although both approaches stress uncertainties in general, two specific uncertainties are made salient: climate change and socio-economic development. Narrowing down uncertainties to these two specific categories facilitates a scenario-based approach. The English first developed the 'route-map approach', which was translated as 'adaptation pathways' and transferred to the Dutch context. The main idea of these approaches is quite progressive, because the Thames Estuary 2100 Plan and the Dutch Delta Programme with its emphasis on 'Adaptive Delta Management' both enable long-term thinking and attempt to avoid measures that could compromise future strategies.

Interestingly, though, both policy approaches also facilitate a rather technical-rational interpretation of adaptability. Both strategy-making processes resulted in the conclusion that the existing system works actually quite well, and mostly requires continuous maintenance and improvement. Adaptability then comes down to 'gradual adjustments over time', or better said, the phasing of interventions. For example, if climate change progresses quickly, dikes also need to be heightened and strengthened more quickly. If not, less interventions are needed. In that way, adaptability is more procedural and instrumental than substantive; it is about speeding up or slowing down the interventions, depending on how external factors develop. The interventions themselves remain rather protection-oriented. To decide if measures need to be taken immediately or whether they can be postponed, both approaches speak about indicators and monitoring systems to ensure that decision makers are well informed on the development of external factors (although the

English approach has been developed further). As explained in chapter 2 and 3, this can be considered a rather technical-rational approach, or as one of the interviewees in the English case said, 'a technical solution to the problem'.

A 'technical solution' or a political choice?

The technical-rational interpretation of adaptability can be better understood in the line of previous turns in flood risk management. As mentioned in chapter 2, the reliance on tools, indicators and monitoring systems shows similarities to how the field of flood risk management dealt with the 'ecological turn' (Disco, 2002) and 'managerial turn' (van den Brink, 2009) in recent decades. These turns have been incorporated with additional ecological standards and performance indicators (Lintsen, 2002; van den Brink, 2009). Indicators have the advantage that they can be controlled, and therefore enable a transparent way of decision-making.

A technical-rational interpretation of adaptability comes across as rather apolitical, but the interpretation of adaptability as gradual adjustments over time fits very well into a policy reality striving for savings and efficiency. It could therefore be argued that the idea of adaptability in both cases is strongly linked to an economic argument (see chapter 2). Understanding adaptability as avoiding over- and underinvestment can also pave the way for postponing investments until the next political cycle. Recognizing this economic underpinning of the strategies, one could also argue that the 'managerial turn' in flood risk management is still ongoing, and seems to be significantly shaping the 'adaptive' turn as well.

The politics behind the current interpretation of adaptability can also be found in the monitoring systems. The best example for this comes from the Dutch case (chapter 3). When the policy agents from the Delta Programme tried to define indicators that can be tracked and followed to enable adaptive decision-making, they noticed that not every indicator 'sends appropriate signals', i.e. presents clear changes. While sea level rise is an indicator that is monitored and projected with a trend line, river discharge has so much variances that it cannot inform your decision-making adequately. Instead of having a traceable indicator, they therefore decided for a fixed worst-case river discharge of 17,000 m3 by 2050 and 18,000m3 by 2100. This shows that defining what is monitored, and how, is rather difficult and essentially remains a (political) choice as well.

'The urge to control' also stems from the perceived need of policy agents to justify their decisions based on the *outcome* of the strategies. The policy agents feel the need to present a clear course of action with comprehensible costs and impacts,

and they are generally encouraged to choose the most cost-effective solution. In the cases of London and Rotterdam, economic cost-benefit analyses have shown that maintaining the existing system of predominantly heightening and strengthening dikes is the most efficient strategy. Using customary methods and tools, there is no decisive reason to switch to a different approach, even when climate change and other (known) uncertainties are taken into account. The strategy-making processes have therefore been driven by 'output legitimacy', i.e. the highest possible stakeholders' acceptance of the outcome (Bekkers & Edwards, 2007; Mees, Driessen, & Runhaar, 2013; Scholten & Hartmann, 2018), and 'engineering and scientific truths', hence measurable data and scientific proof to support the decisions (Hartmann & Driessen, 2017).

The way forward: towards new forms of legitimacy and knowledge

Accepting different forms of legitimacy and knowledge seems to be key to bringing forward the implementation of resilience in flood risk management practice. Other authors have suggested a shift from 'output legitimacy' to 'throughput legitimacy' (Mees et al., 2013; Scholten & Hartmann, 2018). While output legitimacy depends on the extent of stakeholders' acceptance of the proposed strategy, throughput legitimacy is more gained through the process itself. It depends on stakeholders' extent of access to, and influence on, the policy process, and the extent to which deliberation between stakeholders is open, and mutual understanding is encouraged and facilitated. Throughput legitimacy can be measured by the quality of participation and deliberation (Mees et al., 2013).

Shifting to throughput legitimacy also implies that the water domain needs to make more room for multiple forms of knowledge and collaborative processes of knowledge generation, also referred to as 'socially constructed truths' (Hartmann and Driessen, 2017) or 'multidisciplinary knowledge' and 'knowledge co-creation' (van Buuren, 2013). The Dutch Delta Programme has already started to move into this direction with their emphasis on 'joint fact-finding'. However, in the policy process itself, the focus has remained on 'the water system' and hydrology and civil engineering forms of knowledge have dominated (see Chapters 2 and 3, cf. van Buuren, 2013).

To strengthen the adaptive element in both strategies, a stronger focus on monitoring and learning is suggested. As proposed in Chapter 3, the monitoring system itself can be made a more collaborative process (cf. Cundill & Fabricius, 2009), which makes it possible to also include more socio-spatial indicators. A more

collaborative approach can also increase social learning and make the governance process more agile. Moreover, 'throughput legitimacy' and 'knowledge co-creation' asks for a stronger involvement of local stakeholders and citizens. In both cases, it seems recommendable to make better use of local knowledge and local capacities. That way, more room for more substantive visions can be created, measures can be better tailored to the local context, and local ownership can be formed for implementing these measures.

6.4 'Stickiness' and path-dependency

In this thesis, all studied cases have shown signs of 'stickiness' and path-dependency, both in the physical-spatial and social-institutional environment. As described in chapter 3, path-dependency potentially creates 'lock-ins' – situations in which sub-optimal solutions persist because they have materialized in the physical and social environment. In relation to flood risk management, the historic continuity of flood defence infrastructure has been characterized as 'lock-in' before (Huitema & Meijerink, 2010; A. J. Wesselink, Bijker, Vriend, & Krol, 2007; White, 2013). Investments made in the past have materialized in the environment as physical artefacts (e.g. dikes and barriers), which are managed by institutions (e.g. water management authorities). Gralepois et al. (2016) refer to this as the 'stickiness' of the flood defence strategy and the related 'technocratic policy regime'.

'Physical-spatial stickiness'

A main observation from all three cases is that it is difficult to follow a more resilience-oriented approach within the existing flood defence system. In all cases, trust in the existing flood defence infrastructure is high, manifested in the continuation of the flood defence strategy, supplemented with some minor adjustments.

In Rotterdam and Hamburg (chapter 3 and 5), a different – more adaptive and resilience-building – approach is only pursued in areas without existing flood defence infrastructure (i.e. in the HafenCity Hamburg and Rotterdam Stadshaven). The only exemption to the rule is Dordrecht, which follows a multi-layered safety approach, even though it is surrounded by existing dikes. The main reason for this lies in calculations which have shown that parts of Dordrecht's dike ring cannot be heightened and strengthened to provide sufficient safety levels in future. Applying

the multi-layered safety approach can therefore be considered an act of necessity.

As chapters 2 and 4 show, London's emphasis on flood defences in past and present impacts how the adaptive capacity behind the dikes is regarded. Chapter 2 indicated that local authorities can consider the existence of embankments and the Thames Barrier as a reason not to invest too much into riverside strategies and resilience-building measures. A concern that is mirrored in the development of the Royal Docks (chapter 4), when the flood risk assessment was changed and led to less strict building regulations because of the presence of existing defences. London's strong emphasis on flood defences is an exception in the English flood risk management context, though. In general, England is known for following a more diverse flood risk management approach (Wiering, Green, Rijswick, Priest, & Keessen, 2015). London has the advantage that it easily qualifies for national funding for flood defence infrastructure: in London, Defra's principle of an economic return on investment for flood defence infrastructure of 8:1 is effortlessly met, because of its high density of people and businesses.

To sum up, dikes are not only barriers in our physical environment to keep out the water, but they also form constraints in our thinking about alternative ways of flood risk management, limiting creativity and innovation. As has been highlighted before, the 'stickiness' of flood defences is an example of the 'levee effect' (Burby, 2000) or 'escalator effect' (Parker, 1995). Investments from the past lead to the political and economic need to continue with the trajectory of flood defences. This thesis supports the finding from Gralepois et al. (2016) that changes in the flood defence strategies in England and the Netherlands are more 'incremental adaptation instead of real change' in the nature of flood risk management. Gralepois et al. (2016) even speak of a 'backwards trend' in the Netherlands, from more nature-friendly options 'with water' to a 'safety first' approach. Incremental change occurs when 'the regime incorporates some elements of emerging niches without changing its fundamental rationales' (Mattes, Huber, & Koehrsen, 2015: 256). In this thesis, incremental change mainly shows in the prevailing technical-rational interpretation of adaptability (see section 6.2.2).

'Social-institutional stickiness'

The cases also show signs of 'social-institutional stickiness', namely in three aspects: 1) flood risk management strategies have remained rather government- and expert-driven; 2) citizen awareness and involvement is limited in all three cases; and 3) spatial planning and water management mostly remain 'disjointed policy fields'.

Firstly, chapter 2 and 3 have highlighted that the strategy-making processes in the regions of London and Rotterdam have both remained rather government- and expert-driven. The 'in-house team', which has developed the Thames Estuary 2100 Plan, comprised experts from consultancy agencies, the MetOffice and the Environment Agency itself. The Delta Programme has put significant effort into the inclusion of several stakeholders, resulting in a governance approach of governmental stakeholders, experts from consultancies and scientific and social advisory boards. Despite the inclusion of advisory boards, the process still remained driven by experts and the 'four' government layers, i.e. the national government, provinces, municipalities and water boards. Governmental stakeholders and experts are likely to share a common belief system and maintain a somewhat narrow discourse, which can also serve as explanation for the 'stickiness of the technocratic policy regime' (Gralepois et al., 2016; see also Fischer, 1990; Mattes et al., 2015).

Secondly, limited citizen awareness and involvement has been a concern in all three cases. In the English case, the Thames Estuary 2100 Plan mentions low public awareness as one of the problems in London's flood risk management, resulting from centuries of providing high-level protection (chapter 2). In the Royal Docks development, we saw that risk communication hardly takes place, because no one feels responsible for it (chapter 4). So far, also the Delta Programme fell short on communication about flood risks and evacuation possibilities towards citizens (chapter 3). And the Hamburg case shows that the lack of citizen involvement stems from both the government and the citizens: governments often do not actively involve citizens, but if they attempt to do so, many citizens are not really interested in the topic (chapter 5).

Thirdly, this thesis hints at a continuous separation of the two policy fields of urban planning and flood risk management. In the Dutch case, the Delta Programme *Rijnmond-Drechtsteden* mainly focused on the water system (see chapter 2), which explains the limited integration of flood risk management and spatial planning ('every dike is a spatial concept', see chapter 3). Spatial planning has been more central in a different sub-programme, called '*Nieuwbouw en Herstructurering*' (in English: New Urban Developments and Restructering). The work of this sub-programme is now continued with the 'Deltaplan Ruimtelijke Adaptatie' (in English: Delta Plan Spatial Adaptation), which is targeted at making cities climate-proof towards urban floods and the urban heat island effect (Deltaprogramma, 2017). Apparently, the integration of spatial planning and flood risk management is easier when it is not about coastal or river flooding (in Dutch usually associated with '*waterveiligheid*'), but pluvial flooding (in Dutch usually associated with '*wateroverlast*'). The increasing frequencies and magnitudes of heavy rain events represent a new

problem, for which new approaches of flood-proofing the built environment are required. So far pluvial flooding seems to be separated from coastal and river flooding, although such a Delta Plan Spatial Adaptation can also be considered a chance for stronger integration of all sorts of floods into spatial planning in the future.

In Hamburg, the limited integration of spatial planning and flood risk management showed in the 'Leap across the Elbe' project (chapter 5). Only in the HafenCity, an area outside the existing flood defence system, flood risk became a formal concern that was structurally put into land use plans. In London, the limited integration of spatial planning and flood risk management was displayed in a separation of responsibilities. While the Environment Agency is responsible for the flood defences, local authorities are supposed to take on the spatial planning measures of the Thames Estuary 2100 Plan (chapter 4). However, as the Royal Docks case has shown, the pressure for urban growth compromises a more thorough consideration of flood risk into the urban development schemes.

The way forward: Build on strengths and create more room for experiments

'Stickiness' and path-dependency often have a negative connotation, because it can lead to a 'lock-in situation'. A common interpretation is that a lock-in undermines the resilience of a region, because it hinders the adaptation of the flood risk management system, which leaves the region vulnerable to future flood events (White, 2013; Huitema and Meijerink, 2010). However, as Simmie and Martin (2010) have rightly pointed out, one could also argue that a regional flood risk management system itself is resilient, when it is able to maintain its development path, even when it is disturbed by external or internal effects. Path-dependency, and also a lock-in, can then actually be considered as a positive characteristic, because it stands for a situation of strength.

From this line of reasoning, the technical-rational interpretation of adaptability can also be considered advantageous, because it builds on existing strengths of the traditional policy regime (see Chapter 3). Similarly, Hegger et al. (2016) have raised doubts if a diversification of flood risk management measures is always beneficial, because it raises the question if a region can be good at everything.

The fact that the current flood risk management system is not easily overthrown also shows how well the system has actually functioned over the years, and how well it still functions. The current spatial configuration is based on

technologies and management practices, which have coevolved with institutions, legal frameworks and societal perceptions, which all complement and stabilize one another (Liao, 2014; Pahl-Wostl, 2006; Tempels, 2016). On a larger scale, a radical change from the status quo cannot be expected on a short term, also because of the high costs and longevity of the existing dike system (Liao, 2014; Moss, T; Monstadt, 2008).

Nevertheless, well-considered transformational changes at smaller scales are possible (Folke et al. 2010, in Liao, 2014). Creating more room for experiments with a stronger transformative agenda on the local scale seems appropriate (Gunderson, 2010; Liao, 2014; Pahl-Wostl, 2006). In particular, because new predictions for sea level rise lie higher than previously assumed (de Winter et al., 2017). Although it is positive that the existing system is not that easily overthrown, these new insights from climate researchers highlight the importance of long-term thinking and making sure that a system is prepared if extreme scenarios come true. It would therefore be good to continue experimenting with flood resilience measures, which are more spatially integrated and also comprise physical adjustments behind the dikes. That way, new insights and experiences can be gained about what works well, in case more radical system change is needed. Furthermore, and building on the transformative notion of flood resilience, it would be recommendable to make these experiments known to the wider civil society, in order to stimulate a broader social learning process (Pahl-Wostl, 2006). Such a broader social learning process can be beneficial for generating public support and finding new ways of democratic legitimacy, which can help governmental authorities to act quicker in case a more radical change becomes a necessity in the future.

6.5 The growing importance of the local level

A flood resilience approach is considered to require a diversification of flood risk management measures (Aerts, Botzen, van der Veen, Krywkow, & Werners, 2008; Hegger et al., 2014; Mees et al., 2013; Wardekker, de Jong, Knoop, & van der Sluijs, 2010). Diversification means that a balance needs to be found between large scale flood defence infrastructure and more tailor-made flood risk management measures, such as adaptations to individual houses and buildings, risk communication and evacuation plans. While large scale flood defence infrastructure is usually organized centrally, the more tailor made flood risk management measures need to be organized on a regional and local scale (see Chapter 4). The idea is that local input and effort is needed to create local arrangements for legitimized and effective solutions. This means that local authorities gain importance in the field of flood risk

management (Begg, Walker, & Kuhlicke, 2015; Meijerink & Dicke, 2008). Based on the cases of London and Hamburg, this thesis has shown that two important conditions for empowering the local level are (local) *political buy-in* and *clear central guidance*.

The importance of political buy-in (on multiple levels)

Political buy-in appears to be an important condition. In the London case the absence of it on the local borough level was non-conducive to the implementation of the Thames Estuary 2100 Plan, whereas the presence of it in the HafenCity case on the mayor's level helped the implementation of the urban dwelling mound concept. However, both the level of and reasons for political buy-in differed between the cases.

Chapter 4 showed that local authorities saw the lack of local political buy-in as a main obstacle to implement the recommendations of the Thames Estuary 2100 Plan. In particular the idea of riverside strategies, i.e. reserving space for heightening flood defences along the river Thames in a spatially attractive way (e.g. with riverside terraces), would be hard to realize without political support. Because London is facing huge urban growth pressure, local authorities find it difficult to keep development away from the waterfront. For politicians, however, flood risk is not a 'sexy topic' to win voters. As political cycles are short, they prioritize topics which can bring them more votes.

On the other hand, in the HafenCity project in Hamburg the political buy-in at the level of the mayor's office facilitated the implementation of the urban dwelling mound concept (see Chapter 5). The development of the HafenCity was politically wanted, and the flood risk management concept of urban dwelling mounds was evaluated as the cheaper option, also because it allowed faster development of the area than if large-scale embankments had to be built first. The strong political support for the project also made legal changes possible. Hamburg's water law had to be changed, so that in the HafenCity living outside of the dikes was permitted. Therefore, a special act called '*Flutschutzverordnung*' (in English: flood protection ordinance) had to be signed off, which also included the new institution of '*Flutschutzgemeinschaften*' (in English: flood protection communities). In Hamburg, political support was hence also not present because politicians cared so much about flood risk as a topic, but rather because the urban dwelling mound concept fitted into a broader urban agenda. Flood resilience alone seems not to be enough motivation to change the flood risk management strategy; it needs to link with broader political and economic goals.

Central guidance and support: need for clear rules and responsibilities

The two cases from Hamburg and London also show how important central guidance and support are, particularly in the form of clear rules and responsibilities.

In the London case, we could see a lack of ownership for implementing the TE2100 Plan on the local level. The lack of local authorities' awareness and willingness was mostly caused by contextual circumstances. The austerity context has led to budget cuts and high personnel fluctuation and personnel reduction in the boroughs, which puts local authorities like the London Borough of Newham into a 'survival mode'. In Newham, where parallel processes of urban growth and deprivation are taking place, other concerns simply rank higher than flood risk. In the Royal Docks, the lack of clear guidelines for who should inform new residents about flood risk has led to a situation of 'finger-pointing', in which no one, or if at all, the housing developers, are considered to be responsible for risk communication. This responsibility, however, is at odds with their main interest to sell or rent the house (see chapter 4). The London case therefore shows that central guidance and support is particularly important to not overburden local authorities, and to establish clear rules and responsibilities.

Oppositely, in the HafenCity case, where occasional flooding is accepted and the built environment is adjusted accordingly, governmental authorities have set out clear conditions for development and living in the HafenCity. The urban dwelling mound concept has become part of the land use plans, which meant that no other way of building was allowed. Moreover, the above described 'Flutschutzverordnung' including the idea of 'Flutschutzgemeinschaften' regulates the role of property owners in the flood risk management concept of the HafenCity. A locally contextualized urban design solution and the sharing of flood risk management costs and responsibilities between authorities, developers and inhabitants were hence facilitated by clear rules and guidelines. Overall, this shows that the making and implementation of plans is not only dependent on the planning culture, but also the political and economic context.

The way forward: Endowing responsibilities instead of shifting problems

This thesis therefore concludes that, despite the shifts in governance that go along with a flood resilience approach (Johnson & Priest, 2008; Meijerink & Dicke, 2008; Tempels & Hartmann, 2014), the role of governmental authorities does not diminish. In the three cities studies, there was a clear focus on 'safety-first',

organized in a more top-down way. In particular because the government has taken so much responsibility in the past, different approaches (like the HafenCity) need to be induced by the government as well. Central support is still very much needed. Otherwise, the decentralization and privatization of flood risk management responsibilities will only increase risks and shift problems instead of endow responsibilities.

This thesis has also drawn attention to the arising distributional and social justice questions related with the shift from traditional flood control to more locally contextualized flood resilience approaches. Local capacities can strongly differ from each other, which, if not taken into account, can lead to inequalities in protection levels between different areas. It is striking in that respect that the HafenCity case is a neighbourhood with above-average salaries, where property owners as part of a 'Flutschutzgemeinschaft' can afford to outsource their flood risk management responsibilities to a security service. It raises the question if the same flood risk management concept would also have worked in a poorer neighbourhood. Generally, central guidance and support can also be considered important to prevent potentially increasing social injustices.

Moreover, if a flood resilience approach is applied on a broader scale, governmental authorities should not only be cautious of inequalities between municipality A and B, but also, as the Royal Docks case showed, between new and old buildings in the same neighbourhood. The differing views from the planner and the flood risk manager from the Greater London Authority regarding the existing neighbourhoods in the Royal Docks case showed that equity and reducing flood risks can be trade-offs, which clearly leaves room for a morally laden discussion. As stressed by other authors before, translating the concept of resilience from natural to social sciences begs for carefully considering critical questions, such as "resilience from what to what, and who gets to decide?" (Porter & Davoudi, 2012: 331).

One could argue that when it comes to flood resilience measures and spatial integration of water, one of the key future challenges lies in intervening in the existing building stock. Considering that flood resilience measures do not come off the ground easily even in new urban projects, the complexity of ownership and responsibilities in existing built-up areas presents an even more 'wicked problem' for the coming decades.

6.6 Final remarks and suggestions for further research

In sum, this thesis has shown that the concept of resilience resonates lingually

in current flood risk management strategies. However, despite the long-term character of these flood risk management strategies, there is more push for conserving than transforming the existing flood risk management system. The idea of a paradigm shift, associated with resilience when it first entered the flood risk management debate, is less prevalent. Although uncertainties are more strongly put to the foreground, a technical-rational interpretation of adaptability prevails. Acknowledging and emphasizing uncertainties does not automatically lead to fundamentally new approaches, but an incremental adaptation of the existing management system, with an emphasis on 'securing' cities and urban regions against future flood risk.

Based on the main findings presented in sections 6.2 to 6.5, the following four conditions appear to be crucial for implementing a flood resilience approach in urban areas. First, if resilience is framed within a narrative of fear, a shift towards a more integrated and holistic flood risk management – targeted at reducing the probability and the consequences of flooding – is unlikely. Therefore, a positive and broad framing of flood resilience is important – embedded into a broader urban agenda and emphasizing the synergies that a flood resilience approach can create.

Second, current water policy processes are often dominated by governmental stakeholders and experts, engineering- and hydrology-related knowledge and outcome legitimacy, which can facilitate technical-rational interpretations of adaptability and flood resilience. An alternative is to strive for new forms of legitimacy and knowledge, with a stronger emphasis on including local knowledge as well. If more locally tailor-made approaches are desired, local stakeholders should be participating from early on, also to create a sense of local ownership among them.

Third, this thesis has shown that a more resilience based flood risk management approach comes easier off the ground in areas outside the existing flood defence system. Then, a flood resilience approach can be more cost-effective, offer opportunities to share costs and responsibilities among a variety of stakeholders, and create a more attractive living environment by incorporating water into the urban design instead of blocking it out. Transformation, if desired, needs to start in the social system. For this purpose, further capacity-building among public as well as private stakeholders is necessary.

Fourth, political buy-in and central support seem to be crucial for implementing flood resilience in urban areas. Political support is important to ensure that flood risk is not easily put aside in times of austerity and urban growth. Political support can be gained when a flood resilience approach is embedded in a broader economic and urban development agenda. Besides, a flood resilience approach requires a clear division of roles and responsibilities. Therefore, central guidance and

support remains important, and despite several governance shifts in the interplay of state, market and civil society, the overall role of governmental authorities certainly does not diminish.

While this thesis has made a start with examining how the flood resilience concept is brought from theory to practice, further research regarding the meaning-making and implementation process in practice is required. Several avenues for further research are suggested.

This thesis has shown the importance of interpretative policy research for a fuzzy concept like resilience. The multiple meanings of resilience clearly leave room for interpretation. Resilience, when applied in policy and planning, is a far from depoliticized concept. If and how resilience thinking is adopted, is influenced by discursive processes and political choices on multiple levels. This thesis made a start with critically unpacking the notions of 'uncertainty' and 'adaptability' in long-term flood risk management strategies. Further interpretive policy research is encouraged to follow the implementation of the resilience concept in flood risk management practice, and unravel its underlying (political) rationales. As flood risk management is a strong knowledge and expertise-driven field, the science-policy interface, and particularly the role of technical and scientific expertise in shaping policy discourses, is an interesting field for further interpretative policy research (Fischer, 1990; Wesselink, Buchanan, Georgiadou, & Turnhout, 2013).

Moreover, this thesis has studied the development and first implementation steps of the long-term flood risk management strategies in the regions of London and Rotterdam. As these long-term and 'adaptive' flood risk management strategies are a new phenomenon, a close evaluation of the implementation process over the years is necessary. On the one hand, to monitor the potential risk of postponing decisions to a subsequent political cycle. On the other hand, to see which measures are implemented and which are not implemented, when, why and how, and for which reasons.

This thesis has also hinted at path-dependency and 'stickiness'. So far there is often too little evidence for policy-makers to shift to a different flood risk management approach. This highlights the need for more case studies and experiments (Liao, 2014; Pahl-Wostl, 2006; Gunderson, 2010). Policy and science should work hand in hand to design pilot studies with more transformative agendas, requiring also more cooperative and participatory forms of policy inquiry (Fischer, 2009). Even though this knowledge might only be needed later, or the outcome is that such pilots are not functioning at all, such experiments are the only way to gain additional knowledge about certain technologies, costs, governance arrangements and (institutional) learning along the way.

Lastly, this thesis has highlighted the growing importance of the local level in the flood risk management debate. Locally tailor-made approaches ought to deal with differences in local capacities, and therefore raise questions about how resources are distributed. More research regarding (potential) inequalities, and how to prevent them, is necessary (Begg et al., 2015). In 2012, the New York Times headlined 'Forget sustainability. It's about resilience!' (Zolli 2012, cited in (Davoudi, 2018), showing the enormous rise of the resilience concept, which is likely to continue even further. However, unlike sustainability, resilience is not necessarily environmentally and socially just in its original sense. In that vein, recent calls for critically unpacking how resilience is used in (planning) practice remain important (Cote & Nightingale, 2012; Davoudi, 2016; O'Hare & White, 2013), in particular paying attention to social and environmental injustices that might arise.

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